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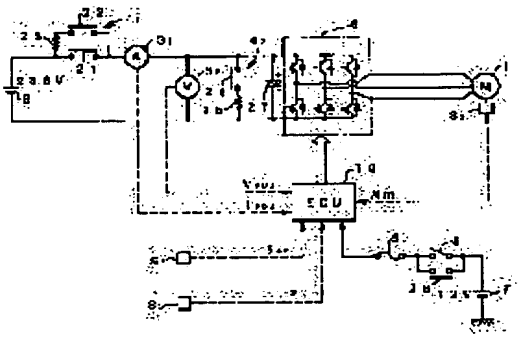
(54) DETERIORATION DISCRIMINATING DEVICE FOR CAPACITOR IN MOTOR-DRIVEN VEHICLE

(57)Abstract:
PURPOSE: To discriminate the deterioration of a smoothing capacitor provided at the inverter of a motor-driven vehicle without detaching the capacitor.
CONSTITUTION: The smoothing capacitor 27 of an inverter 6 is charged with a precharger contactor 22 turned on before turning on a motor contactor 21. The increasing rate of the voltage of the capacitor 27 is detected by a voltage sensor S2. If the increasing rate exceeds a prescribed value, it is discriminated as the capacitor 27 deteriorated. The capacitor 27 of the inverter 6 is discharged with a discharge contactor 24 turned on after turning off the motor contactor. If the increasing rate of the voltage of the capacitor 27 detected by the voltage sensor S2 exceeds a prescribed value, it is discriminated that the capacitor 27 has deteriorated.



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CLAIMS

[Claim(s)]
[Claim 1] The inverter which changes into alternating current power the direct current power which a dc-battery (3) and a dc-battery (3) output (6), In the electric car equipped with the drive motor (1) driven with the alternating current power which an inverter (6) outputs, and the capacitor (27) connected to the inverter (6) at juxtaposition A charge means (41) to charge a capacitor (27), and an electrical-potential-difference detection means to detect the electrical potential difference of a capacitor (27) (S2), Degradation judging equipment of the capacitor in the electric car characterized by having a degradation judging means (10) to judge degradation of this capacitor (27) based on the change condition of the electrical potential difference of the capacitor (27) detected with the electrical-potential-difference detection means (S2) at the time of actuation of a charge means (41).
[Claim 2] The inverter which changes into alternating current power the direct current power which a dc-battery (3) and a dc-battery (3) output (6), In the electric car equipped with the drive motor (1) driven with the alternating current power which an inverter (6) outputs, and the capacitor (27) connected to the inverter (6) at juxtaposition A discharge means (42) to discharge a capacitor (27), and an electrical-potential-difference detection means to detect the electrical potential difference of a capacitor (27) (S2), Degradation judging equipment of the capacitor in the electric car characterized by having a degradation judging means (10) to judge degradation of this capacitor (27) based on the change condition of the electrical potential difference of the capacitor (27) detected with the electrical-potential-difference detection means (S2) at the time of actuation of a discharge means (42).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the degradation judging equipment of the capacitor in the electric car equipped with the dc-battery, the inverter which changes into alternating current power the direct current power which a dc-battery outputs, the drive motor driven with the alternating current power which an inverter outputs, and the capacitor connected to the inverter at juxtaposition.
[0002]
[Description of the Prior Art] It is equipped with the electrolytic capacitor for graduating fluctuation of an electrical potential difference and stabilizing actuation of an inverter between the terminals of the input side of the inverter of an electric car (for example, refer to JP,4-165901,A).
[0003] By the way, if the life of said capacitor changes according to the operational status of a motor, for example, the high voltage joins a capacitor by the abnormalities in regeneration, degradation phenomena, such as a liquid spill and a capacity fall, will occur, and a life will become short. Then, conventionally, the capacitor was removed from the inverter and the life was judged by measuring the capacity.
[0004]
[Problem(s) to be Solved by the Invention] However, by the above-mentioned conventional technique, the capacitor needed to be periodically removed from the inverter, the life needed to be judged, and the activity was troublesome.
[0005] This invention aims at enabling it to judge a life with an onboard condition, without having been made in view of the above-mentioned situation, and removing a capacitor from an inverter.
[0006]
[Means for Solving the Problem] In order to attain said purpose, invention indicated by the claim 1 publication In the electric car equipped with the dc-battery, the inverter which changes into alternating current power the direct current power which a dc-battery outputs, the drive motor driven with the alternating current power which an inverter outputs, and the capacitor connected to the inverter at juxtaposition It is characterized by having a degradation judging means to judge degradation of this capacitor based on the change condition of the electrical potential difference of the capacitor detected with the electrical-potential-difference detection means at the time of actuation of a charge means to charge a capacitor, an electrical-potential-difference detection means to detect the electrical potential difference of a capacitor, and a charge means.
[0007] Moreover, the inverter from which invention indicated by claim 2 changes into alternating current power the direct current power with which a dc-battery and a dc-battery output, In the electric car equipped with the drive motor driven with the alternating current power which an inverter outputs, and the capacitor connected to the inverter at juxtaposition It is characterized by having a degradation judging means to judge degradation of this capacitor based on the change condition of the electrical potential difference of the capacitor detected with the electrical-potential-difference detection means at the time of actuation of a discharge means to discharge a capacitor, an electrical-potential-difference detection means to detect the electrical potential difference of a capacitor, and a discharge means.
[0008]
[Function] According to the configuration of claim 1, when charging a non-charged capacitor with a charge means, an electrical-potential-difference detection means detects the electrical potential difference of this capacitor, and based on the change condition of the electrical potential difference of the capacitor, a degradation judging means judges degradation of a capacitor.
[0009] According to the configuration of claim 2, when discharging a charged capacitor with a discharge

means, an electrical-potential-difference detection means detects the electrical potential difference of this capacitor, and based on the change condition of the electrical potential difference of the capacitor, a degradation judging means judges degradation of a capacitor.
[0010]
[Example] Hereafter, the example of this invention is explained based on a drawing.
[0011] The flow chart with which drawing in which drawing 1 - drawing 5 show one example of this invention, and drawing 1 shows the whole electric car configuration, and drawing 2 explain the block diagram of a control system, and drawing 3 explains the operation at the time of charge, the flow chart with which drawing 4 explains the operation at the time of discharge, and drawing 5 are the graphs explaining an operation.
[0012] As shown in drawing 1 and drawing 2 , the electric car V of four flowers has the front wheels Wf and Wf of a Uichi Hidari pair as a driving wheel which the torque of the three-phase-alternating-current motor 1 is delivered through a differential 2, and the rear wheels Wr and Wr of a Uichi Hidari pair as a coupled driving wheel. For example, the 288-volt Maine dc-battery 3 is connected to a motor 1 through the inverter 6 which was carried in the posterior part of the electric car V and which constitutes the motor contactor 21, the precharge circuit 41, a joint box 5, the discharge circuit 42, and a power drive unit. For example, the electronic control unit 10 connected to the 12-volt subdc-battery 7 through the main switch 8 and the fuse 9 is connected to an inverter 6 that the driving torque and regeneration torque of a motor 1 should be controlled. A battery charger 11 and DC to DC converter 12 are formed that the subdc-battery 7 should be charged with the power of the Maine dc-battery 3.
[0013] Precharge circuit 41 connected to the motor contactor 21 and juxtaposition It consists of the precharge contactors 22 and the precharge resistance 23 which were connected to the serial. Moreover, discharge circuit 42 It consists of the discharge contactors 24 and the discharge resistance 25 which were connected to the serial. Furthermore, the backup contactor 26 is connected to juxtaposition at a main switch 8.
[0014] Said electronic control unit 10 constitutes the degradation judging means of this invention, and is said precharge circuit 41. And discharge circuit 42 The charge means and discharge means of this invention are constituted, respectively.
[0015] In the direct-current section which connects the Maine dc-battery 3 and an inverter 6, it is the current IPDU. Current sensor S1 to detect Electrical potential difference VPDU Voltage sensor S2 to detect It is prepared and is a current sensor S1. Current IPDU of the direct-current section of the detected inverter 6 And voltage sensor S2 Electrical potential difference VPDU of the direct-current section of the detected inverter 6 It is inputted into an electronic control unit 10. Moreover, motor rotational frequency sensor S3 The detected several Nm motor rotation and accelerator opening sensor S4 Detected accelerator opening thetaAP and shift position sensor S5 The detected shift position P is inputted into an electronic control unit 10.
[0016] By having two or more switching elements, getting down from them, and inputting a switching signal into each SUITCHIINGU component from an electronic control unit 10, an inverter 6 changes the direct current power of the Maine dc-battery 3 into three-phase-alternating-current power at the time of the drive of a motor 1, is supplied to this motor 1, changes into direct current power the three-phase-alternating-current power which this motor 1 generated at the time (at the time of regeneration) driven [of a motor 1], and supplies it to the Maine dc-battery 3. Moreover, it is equipped with the capacitor 27 for smooth which consists of an electrolytic capacitor between the high potential input terminal of an inverter 6, and a low voltage input terminal. The electrical potential difference under charge of a capacitor 27 and discharge is said voltage sensor S2. It is detected.
[0017] the field by the side of the high engine speed after PWM (pulse width modulation) control of the inverter 6 is carried out in the field by the side of the low engine speed of a motor 1 and the rate of duty of PWM control reaches to 100% -- being the so-called -- field-weaking control is carried out. Field-weaking control gives a field current component to the primary current supplied to a motor 1, weakens the whole field, and extends the rotational frequency of a motor 1 to a high rotational frequency side so that the field which the permanent magnet of a motor 1 has generated, and the field of hard flow may occur.
[0018] Next, based on drawing 3 and drawing 5 , the operation at the time of charge of a capacitor 27 is explained.
[0019] First, if a main switch 8 is turned on at time of day T= 0, the backup contactor 26 will turn on and an electronic control unit 10 will be in an operating state (step S1). Time amount T1 It passes and is time-of-day T=T1. If it becomes, the precharge contactor 22 turns on, a current flows from the Maine dc-battery 3 to

a capacitor 27 through the precharge resistance 23, and charge of a capacitor 27 is started (step S2). While the precharge contactor 22 turns on, it is a voltage sensor S2. Electrical potential difference V1 of a capacitor 27 It detects (step S3).
[0020] After the precharge contactor 22 turns on, it is predetermined time t1. In the elapsed time of day T2, while the motor contactor 21 is turned on (step S4), the precharge contactor 22 is turned off (step S5). And while the precharge contactor 22 is turned off, it is a voltage sensor S2. Electrical potential difference V2 of a capacitor 27 It detects (step S6). In addition, said predetermined time t1 It is set up shorter than the time amount which charge of a capacitor 27 completes.
[0021] Then, said predetermined time t1 Rate dV/dt of the change of potential of the capacitor 27 which can be set is computed by dV/dt= (V2-V1) / t1 (step S7). And when said rate dV/dt of the change of potential is larger than the 1st predetermined value and the rate of increase of the electrical potential difference at the time of charge of a (step) S8 27, i.e., a capacitor, is large, it detects that the capacitor capacity C fell from the fall of a time constant (product of the capacitor capacity C and the precharge resistance R), it is judged that the capacitor 27 has deteriorated, and an alarm is emitted at a lamp or a buzzer (step S9).
[0022] It ** and the following usual transit control is performed in step S10.
[0023] Namely, motor rotational frequency sensor S3 The detected several Nm motor rotation and accelerator opening sensor S4 Detected accelerator opening thetaAP and shift position sensor S5 Based on the detected shift position P, a driver computes the torque command value which it is going to make the motor 1 generate by map retrieval. There are a driving torque command value and a regeneration torque command value as torque command value, a driving torque command value corresponds, when making a motor 1 generate driving torque, and a regeneration torque command value corresponds, when making a motor 1 generate regeneration torque. Then, the target power which should be supplied or taken out from a motor 1 by regeneration on a motor 1 is computed by carrying out the multiplication of the several Nm motor rotation detected by the motor rotational frequency sensor S3 to said torque command value, and doing the division of this with conversion efficiency. Target power has the case of a positive value, and the case of a negative value, forward target power corresponds, when a motor 1 generates driving torque, and negative target power corresponds, when a motor 1 generates regeneration torque.
[0024] On the other hand, it is a current sensor S1. Current IPDU of the direct-current section of the detected inverter 6 Voltage sensor S2 Electrical potential difference VPDU of the direct-current section of the detected inverter 6 By carrying out multiplication, the true power inputted into an inverter 6 is computed. There are a case of a positive value and a case of a negative value also in true power, like target power, forward true power corresponds, when a motor 1 generates driving torque, and negative true power corresponds, when a motor 1 generates regeneration torque.
[0025] And deflection with said target power and true power is computed, and field control of the motor 1 is carried out in slight PWM control or weakness through an inverter 6 in order to complete the deflection as zero.
[0026] Next, based on drawing 4 and drawing 5 , the operation at the time of discharge of a capacitor 27 is explained.
[0027] First, when an operator turns off a main switch 8, it judges whether a car is stopping based on several Nm motor rotation or the vehicle speed, or it is under transit (step S11), and the usual transit control mentioned above when the car was running is performed (step S12). In addition, since the predetermined time amount backup contactor 26 is maintained by ON condition even if a main switch 8 turns off, the function of an electronic control unit 10 is maintained as it is.
[0028] On the other hand, if a car is stopping at step S11, the motor contactor 21 turns off by OFF of a main switch 8 (step S13). Time-of-day T3 after the motor contactor 21 turns off It sets, the discharge contactor 24 turns on (step S14), and it is the electrical-potential-difference sensor S2 to it and coincidence. The electrical potential difference V3 of a capacitor 27 is detected (step S15).
[0029] the charge stored in the capacitor 27 by ON of the discharge contactor 24 is consumed by the discharge resistance 25 -- having -- said time-of-day T3 from -- predetermined time t2 Elapsed time-of-day T four at the same time it sets and turns off the discharge contactor 24 (step S16) -- voltage sensor S2 Electrical potential difference V4 of a capacitor 27 It detects (step S17). In addition, said predetermined time t2 It is set up shorter than the time amount which discharge of a capacitor 27 completes.
[0030] Then, said predetermined time t2 Rate dV/dt of the change of potential of the capacitor 27 which can be set is computed by dV/dt= (V3-V4) / t2 (step S18). And when said rate dV/dt of the change of potential is larger than the 2nd predetermined value and the percentage reduction of the electrical potential difference at the time of discharge of a (step) S19 27, i.e., a capacitor, is large, it detects that the capacitor capacity C fell

from the fall of a time constant (product of the capacitor capacity C and the discharge resistance R), it is judged that the capacitor 27 has deteriorated, and an alarm is emitted at a lamp or a buzzer (step S20). It **, and in step S21, when the backup contactor 21 turns off, the function of an electronic control unit 10 stops.
[0031] In addition, it becomes a value with the 1st predetermined value used as the criteria of the degradation judging at the time of charge and the 2nd predetermined value used as the criteria of the degradation judging at the time of discharge respectively separate [the precharge resistance 23 and the discharge resistance 25] since resistance differs.
[0032] Since the degradation judging of a capacitor 27 can be performed with an onboard condition, without removing this capacitor 27 from an inverter 6 as mentioned above, the time amount which the maintenance of a capacitor 27 takes is sharply reducible.
[0033] As mentioned above, although the example of this invention was explained in full detail, this invention can perform design changes various in the range which does not deviate from the summary.
[0034] For example, discharge circuit 42 of an example Although it is an easy thing only using resistance, a much more exact judgment can be performed without this being influenced by the electrical potential difference of a current regulator circuit, then the Maine dc-battery 3 etc.
[0035]
[Effect of the Invention] As mentioned above, since according to invention indicated by claim 1 an electrical-potential-difference detection means detects the electrical potential difference of this capacitor and a degradation judging means judges degradation of a capacitor based on the change condition of the electrical potential difference of the capacitor when charging a non-charged capacitor with a charge means, without removing a capacitor, it becomes possible to judge a degradation condition and workability improves.
[0036] Moreover, since according to invention indicated by claim 2 an electrical-potential-difference detection means detects the electrical potential difference of this capacitor and a degradation judging means judges degradation of a capacitor based on the change condition of the electrical potential difference of the capacitor when discharging a charged capacitor with a discharge means, without removing a capacitor, it becomes possible to judge a degradation condition and workability improves.

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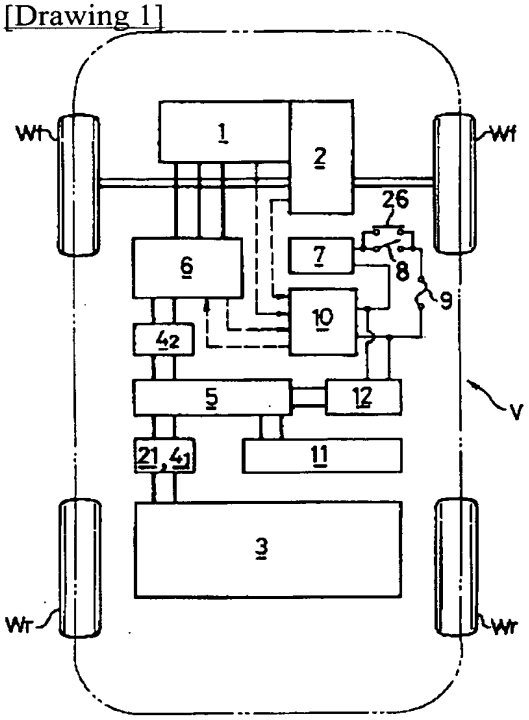
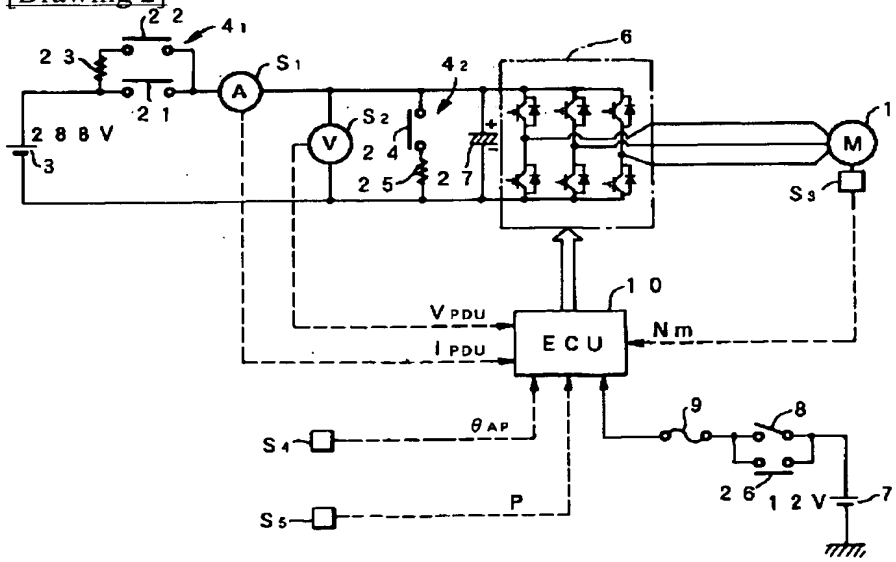
DRAWINGS

[Drawing 1]



[Drawing 2]



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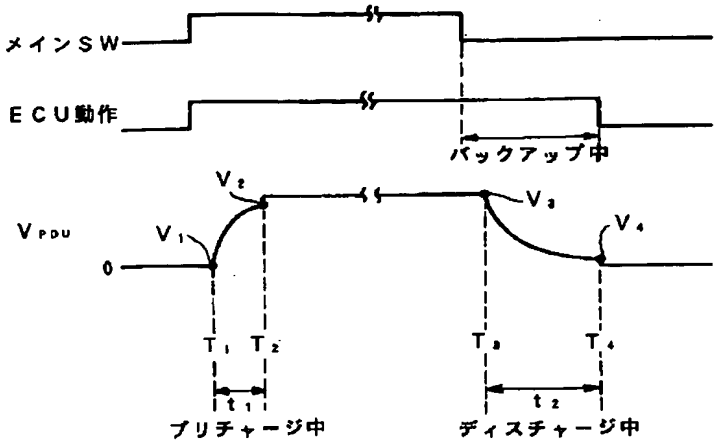
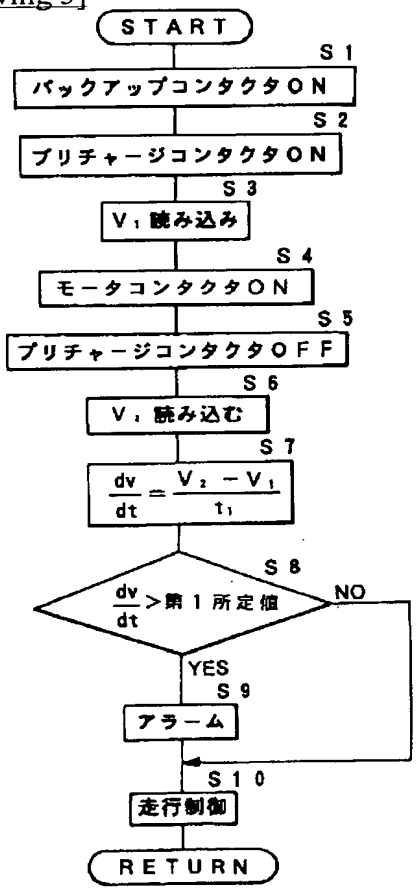
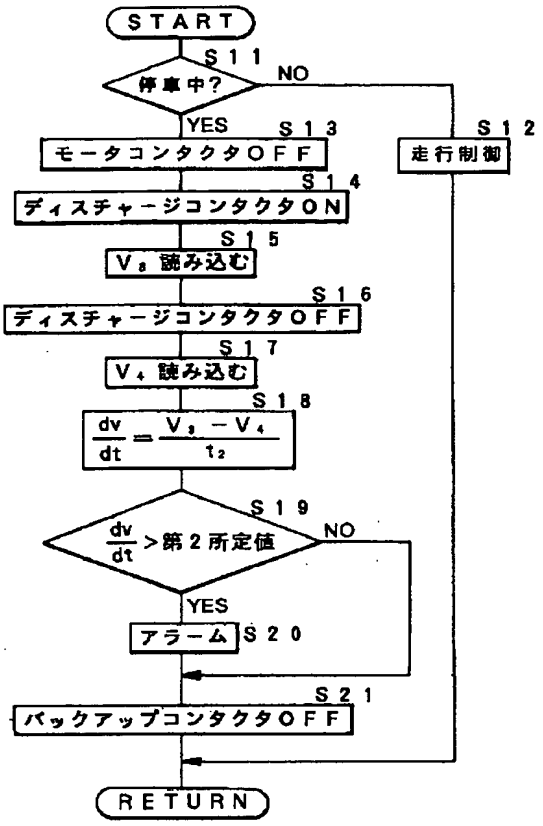


[Drawing 3]



[Drawing 4]



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